JEM 3010 HIGH RESOLUTION TRANSMISSION ELECTRON MICROSCOPE

OPERATING INSTRUCTIONS

JEM 3010, a 300KV JEOL make High resolution analytical TEM has been born out of the ultra high resolution TEM techniques. One can directly carry out Ultra micro area X-ray analysis, micro area analysis, electron diffraction, convergent beam electron diffraction while observing structure images which show atomic arrays. Thus, permitting more accurate structural analysis.

Operating Panel:

The operating panel has a minimum number of switches and controls placed in an easy to use layout. This is combined with a personal file scheme, which together provides much easier operating environment.

The operating panel is divided into 6 modules 3 on either side of the main column to understand key locations during description of operating procedures, namely

1. L1- top left panel, **Column** (opearator) 2. R1- Top right panel

3 L2 -middle left panel. **Column**(opearator) 4. R2- bottom right panel.

5. L3- Bottom Left panel **Column**(opearator) 6. R3- Bottom right panel

Please see the above figure.

During description each button/switch will be referred according to the panel in which it is located.

For example: Lens power supply switches L3-2 and L3-3 means switches 2 and 3 on left bottom panel 3. Name of these switches are also written on the panels.

Panel L-1

Panel R-1

SAFETY PRECAUTIONS

For the proper use of the instrument, please read following safety precautions prior to starting operation.

- Do not remove the grounding wire. Improper grounding may cause electrical shock.
- Do not mount on the operating table and/or console

- Do not dismount and / or reassemble the microscope column. The column dismounting and reassembling is allowed to only Jeol Engineer.
- Do not touch the parts with safety labels on them.
- Be careful not to pinch your fingers between the specimen holder and goniometer when inserting the holder into the goniometer.
- Do not put your hand between the upper and lower electron gun chambers while the electron gun lift is functioning.
- Please read the JEM 3010 instruction manual (available with EMU) completely before actually operating the instrument.

5.2.1 START UP PROCEDURE:

1. Make sure that:
    a. The Lens Power supply switches (L3-2) and Lens(L3-1) are set at ON.
    b. The Gun air and column air switches (L2-8 and 9) are off (the built lamps are dim).
    c. The compressed air pressure is 0.35 to 0.45 MPa (gauge pressure).
    d. The Nitrogen cylinder main valve is tuned On and pressure is around 1 bar.
    e. The UNA switch is set at OFF.

2. Turn ON the main power switch on the distribution board.
3. Turn the POWER switch Key clockwise to START via ON, hold it at START position for five seconds, then release the key and wait for the ACCEL VOLTAGE READY lamp(L1-3) to light up.
4. Make sure water chiller is running and the temperatures are same as set temperatures (18 deg C).
5. While waiting make a note of number of Unused films on the CRT (R-1). If unused films are 0 then load fresh set of films from the desiccator.

5~2.2 Film Loading

5.2.2a. Loading films into the dispensing magazine

1. Remove the lid from the dispensing magazine and fully depress the bottom plate until it is clamped.
   Note: This procedure should be carried out under a safelight in a dark room.
2. Insert an unexposed film into each cassette with the emulsion side facing up (Fig.5.2.1).
3. Place the loaded cassettes in the dispensing magazine and replace the magazine lid. Up to 50 cassettes can be loaded in one magazine.

Note: Do not mistake the dispensing magazine for the receiving magazine (see Fig. 5.2.2).

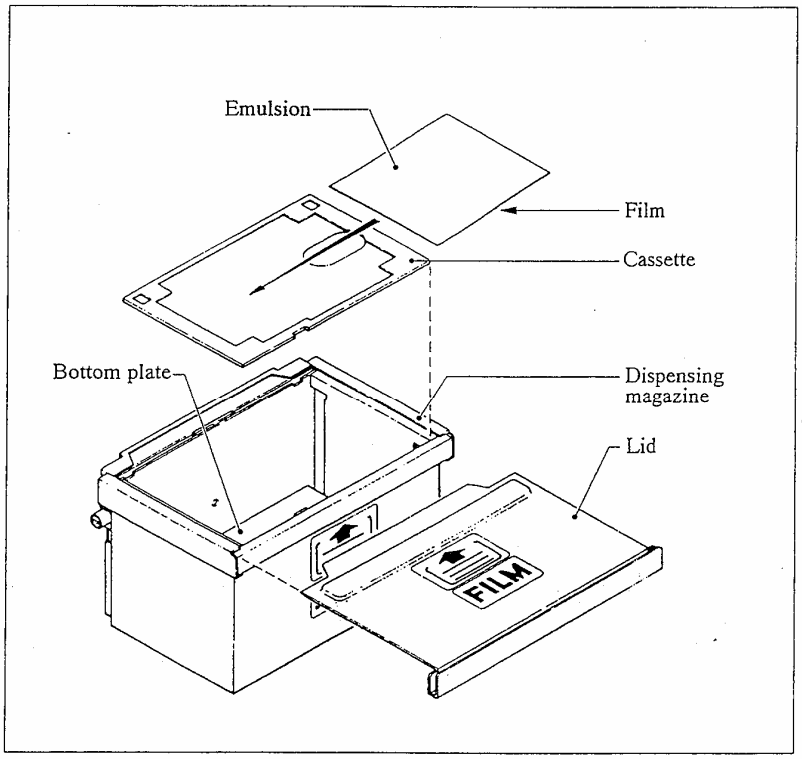


Fig. 5.2–1 Loading films into the dispensing magazine

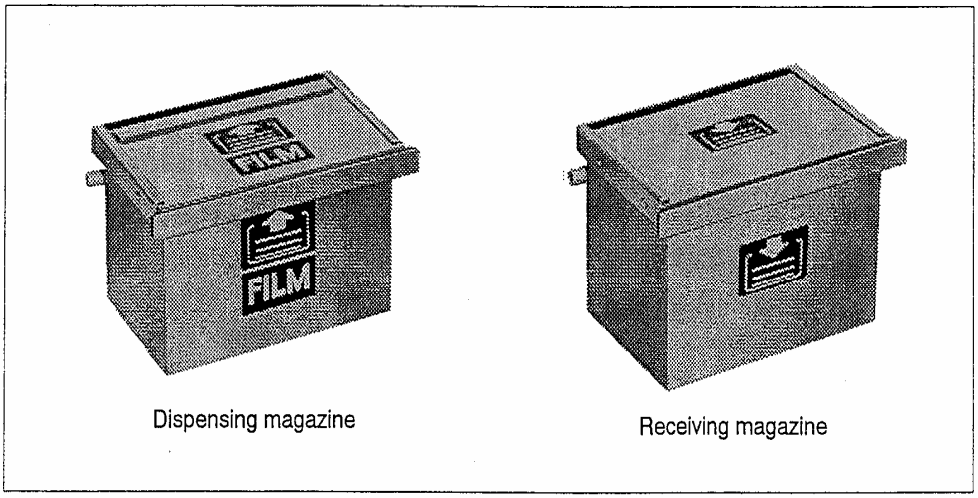


Fig. 5.2–2 Magazines

5.2.2b. Inserting (or removing) the magazines into (or from) the camera chamber

1. Make sure there is no unused film in the camera chamber. The number of unused films is indicated after "UNUSED" on PAGE-1 (Fig. 5.2-3) displayed on the CRT (R1-14). That is, if the number decreases to 2, 1 and then returns to 50, there is no unused film in the camera chamber. If PAGE-1 is not being displayed on the CRT, make the CRT display PAGE-1 in accordance with Sect. 5.2.9.

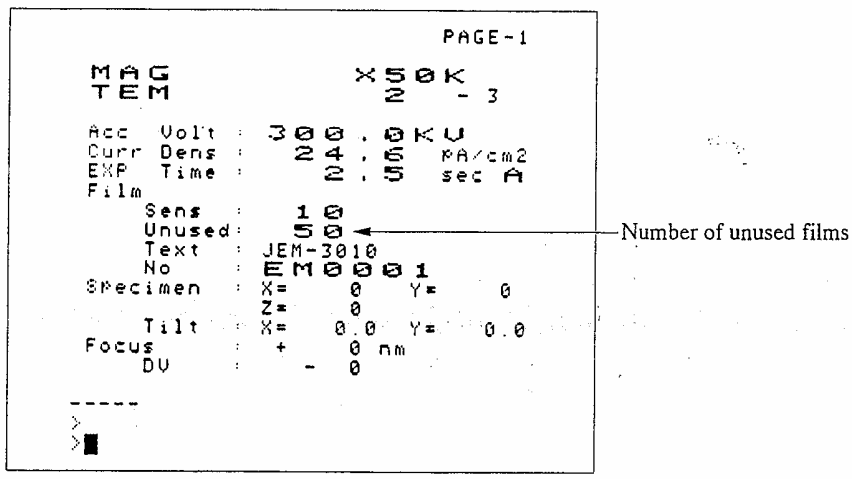


Fig. 5.2–3 PAGE–1

2. Make sure the FILAMENT knob (L1-8) is set at OFF and the PHOTO switch lamp (R1-8) is not lit. If the PHOTO switch lamp is on, turn off the FILM ADVANCE AUTO switch (R1-l1) and depress the PHOTO switch.
3. Open the nitrogen gas source valve and turn the camera chamber door handle (Fig. 5.2-4) clockwise until it stops (about 90deg).

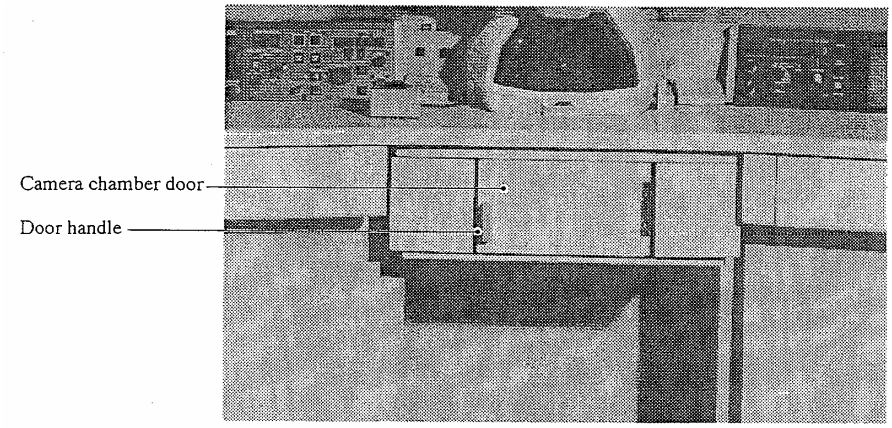


Fig. 5.2–4 Camera chamber

4. Open the camera chamber door and close the nitrogen source valve. If the door does not open in five minutes after turning the door handle clockwise, turn the handle fully counterclockwise, then turn the handle clockwise again and wait for another five minutes. Repeat this turning and waiting until the door opens.

Notes: 1. If the gas source valve is not open and/or no nitrogen gas is stored, the camera Chamber door does not open.

2. Carry out Steps 5 to 9 as quickly as possible so as to avoid exposing the camera

Chamber to the atmosphere longer than absolutely necessary.

5. Draw out the magazine stand by pulling the handle (Fig. 5.2-5).

CAUTION

Do not touch the camera drive mechanism in the camera chamber.

6. If there is an empty dispensing magazine in the magazine stand, remove it by lifting it out. Then place the dispensing magazine loaded with unexposed films squarely in the magazine stand.

Notes:

1. If the magazine is not placed squarely in the magazine stand, it will be impossible to insert the magazine stand smoothly.
2. Two dispensing magazines and two receiving magazines (Fig. 5.2-2) are provided in order to enhance throughput.That is to say, while one dispensing magazine is being used, the other can be kept in the desiccator (optionally available) so that the loaded films are ready and demoisturized when needed. Also, as one receiving magazine is being filled during the course of photography, the second one can be Icept handily, ready for the next sequence of filming.
3. When handling the magazines, hold them so as to prevent the magazine lid from dropping out.

7. If there is a receiving magazine loaded with exposed films in the magazine stand, remove it by lifting it out and replace it with an empty receiving magazine.

Note: Never remove the lid from a loaded magazine outside a dark room.

8. Push the magazine stand fully in.

9. Close the camera chamber door and, while holding it closed, turn the door handle counter- clockwise as far as it will go.

Note: Before closing the camera chamber door, check the 0-ring and its contact surfaces for dust, lint, etc. A dirty 0-ring may adversely affect the camera chamber vacuum.

10. Write the number of unused films (the number of films loaded in the dispensing magazine) on the CRT.

a. Let the CRT display PAGE-i (see Sect. 5.2.11).

b. Enter FUN 4 through the keyboard.

c. Set the UNUSED number (Fig. 5.2-6) to accord with the number of unused films (see Sect.5.2.11).

d. Depress the 4 key.

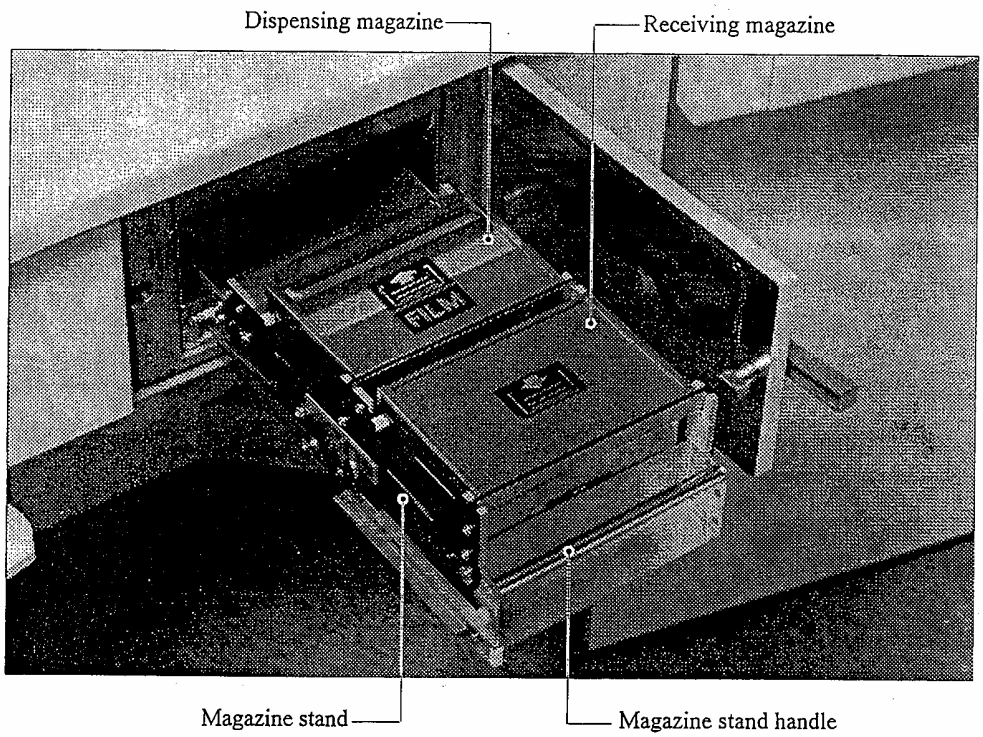


Fig. 5.2–5 Magazine stand

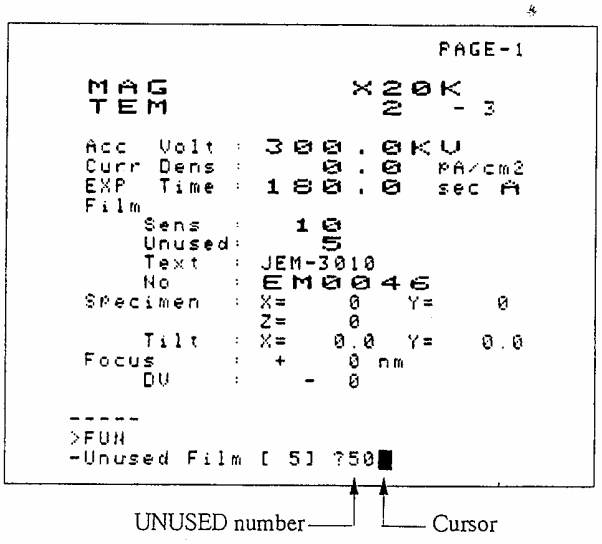


Fig. 5.2–6 Writing the UNUSED number

5.2.3 Loading the Specimen Holder with a Specimen.

1. Remove the specimen holder from the microscope column (see Sect. 5.2.5).
2. Insert the cartridge removing tool into the cartridge securing jaw, raise the jaw with the tool and remove the specimen cartridge (see Fig. 5.2-7).
3. Use the specimen loading tool to unscrew the specimen securing nut, remove the washer and specimen (see Fig. 5.2-8). Unscrew the nut after aligning the claws on the tool with the cuts on the nut.

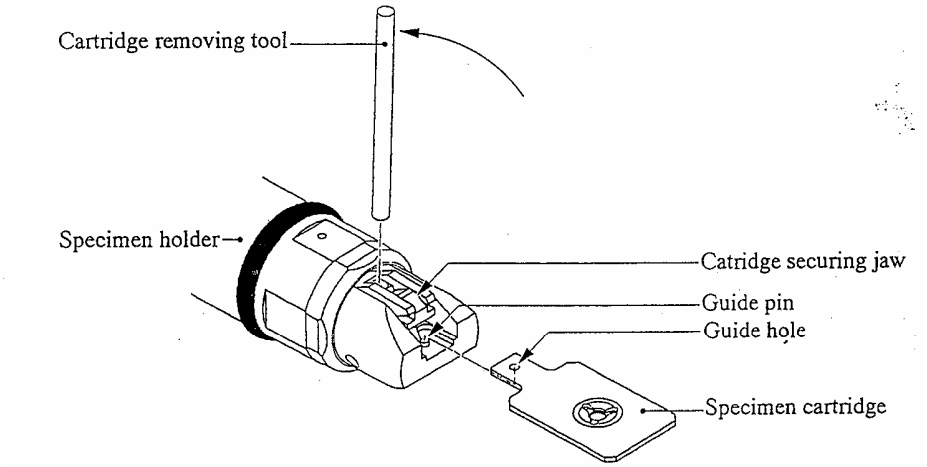


Fig. 5.2–7 Cartridge removing

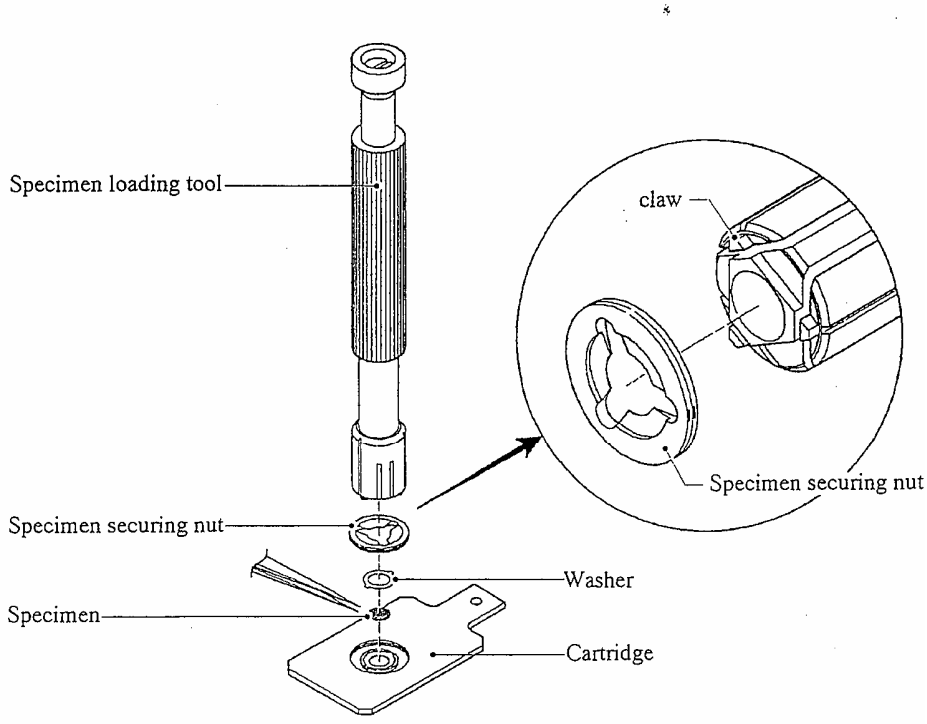


Fig. 5.2–8 Specimen loading

4. Place a specimen grid with the specimen facing upward in the specimen cartridge and the washer on the specimen (Fig. 5.2-9).
1. Secure the specimen grid with the specimen securing nut using this specimen loading tool. That is; place the nut on the washer, insert tool claws in the nut and screw the nut with the tool.

Note: If the specimen grid and washer are not placed correctly, the specimen grid will not be secured.

6. Raise the cartridge securing jaw with the cartridge removing tool (Fig. 5.2-7).
7. Place the specimen cartridge end under the cartridge securing jaw so that the guide pin under the jaw is inserted in the cartridge guide hole (Fig. 5.2-7). And make sure that the cartridge is tightly secured with the jaw (there should be no gap between the jaw and cartridge).

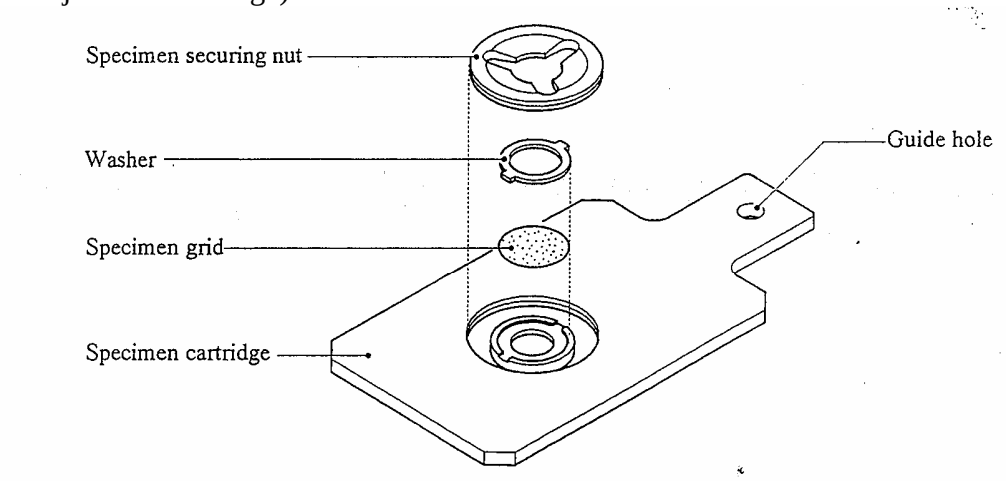


Fig. 5.2–9 Specimen loading

5~2~4 Inserting the Specimen Holder in the Microscope Column

1. Make sure that there is no dust and/or lint on the specimen holder 0-ring.
2. Align the specimen holder guide pin with the guide groove on the microscope column (Or goniometer), push the holder in the goniometer until it stops and set the goniometer PUMP/AIR switch (Fig. 4.1-3) to PUMP. The yellow lamp lights up and the goniometer evacuation commences.

Notes:

1. Do not turn the holder while carrying out this step.
2. The goniometer evacuation will not be performed in the fallowing cases.
   * When values Vi and V2 are closed.
   * When the P15 reading (the reading on the meter (L2-1O) when the vacuum gauge
   * selector (L2-7) is set at P15) is higher than 150 ,aA with valve V13 open.

   * To perform the goniometer evacuation, wait until valves Vi and V2 are open if closed, and wait until the P15 reading decreases to 150 jiA or less if it is higher than 150uA. The valve functioning is displayed on the diagram (L2-13).

3. The PUMP/AIR switch setting cannot be performed unless the switch is pulled.

3. When the, green lamp lights up (i.e., the goniometer evacuation is complete), slightly turn the

holder clockwise and push it in and further turn it clockwise and push it in completely.

⚠CAUTION

- Be careful not to pinch your fingers between the specimen holder and goniometer.
- Always hold the specimen holder while the holder is being inserted into the goniometer. If you do not do so, the specimen holder may hit the goniometer causing damage to the goniometer due to the force of vacuum.

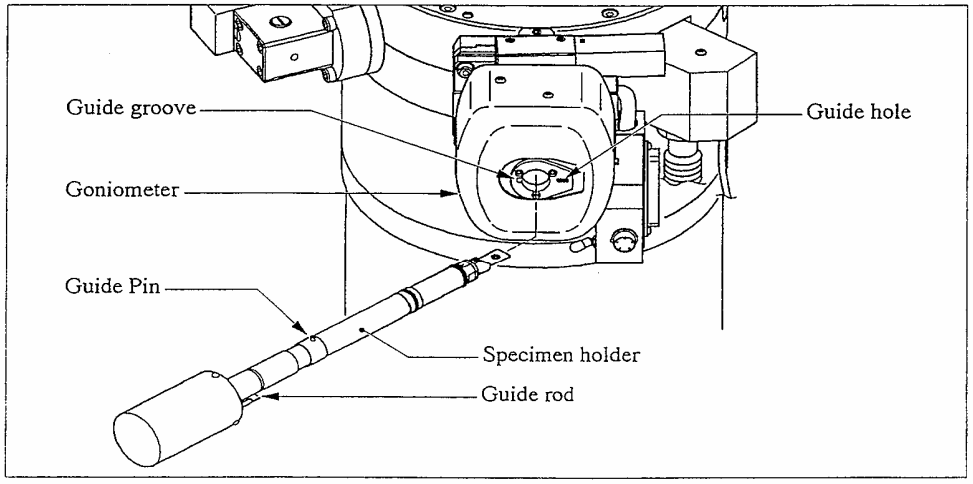


Fig. 5.2–10 Specimen holder insertion

5.2.5 Removing the Specimen Holder from the Microscope Column

1. Set the FILAMENT (L1-7) to OFF.
2. Open the nitrogen gas source valve.
3. Pull the specimen holder, turn it counterclockwise, pull it, turn it again counterclockwise completely.
4. Set the goniometer PUMP/AIR switch (Fig. 4.1-2) to AIR, wait for 30 seconds and remove the holder.

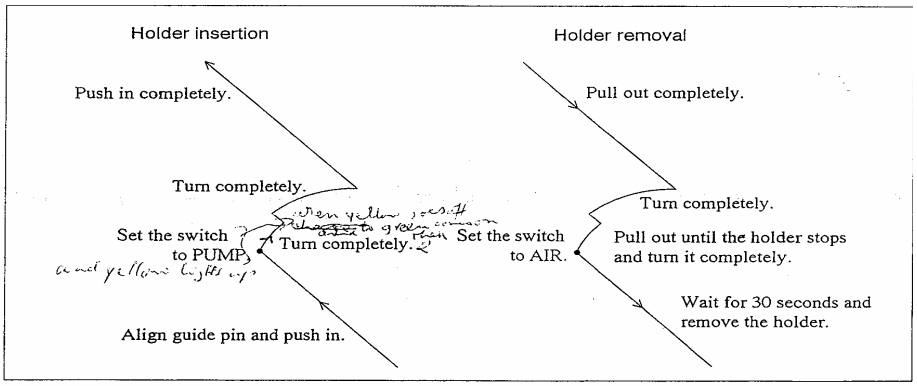

Holder insertion
Holder removal
Push in completely.
Pull out completely.
Turn completely.
Turn completely.
Set the switch to PUMP.
Turn completely.
Set the switch to AIR.
Pull out until the holder stops and turn it completely.
Wait for 30 seconds and remove the holder.
Align guide pin and push in.

Fig. 5.2–11 Specimen holder motion diagrams

5.2~6 Electron Beam Generation

1. Confirm every three months that the reading of the pressure meter on the HT tank is 1.7 or more. If less, rep1enisl~ the tank with gas (see the maintenance manual).
2. Confirm that the column pressure is lower than 10 exp-4 Pa.
   Note: The column pressure is indicated on the meter (L2-1O) when the vacuum gauge selector (L2-7) is set at PEG. Use the lower (inner) Pa scale when the L lamp on the left side of the meter is lit, and the upper (outer) Pa scale when the H lamp is lit
3. Make sure that the ACCEL VOLTAGE READY lamp (L1-3) is lit and the FILAMENT (L1-8) is set at OFF.
4. Make sure that the dispensing and receiving magazines are in the camera chamber (see Sect.5.2.2b) and the specimen holder is in the goniometer (see Sect. 5.2.4).

Note: When the specimen holder is not in the goniometer, election beam generation is impossible.

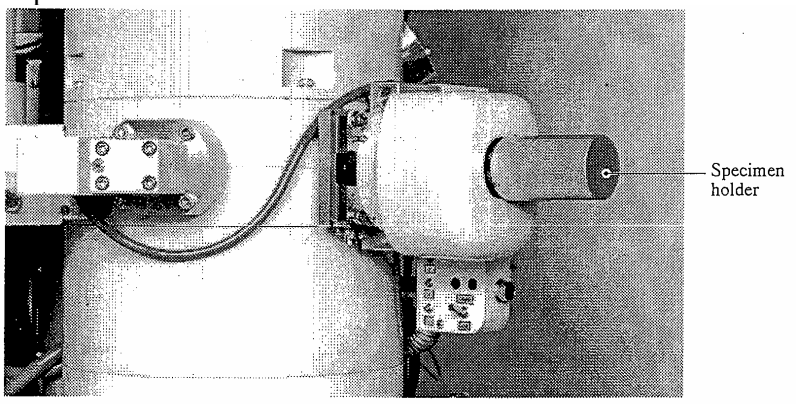


Fig. 5.2–12 Specimen holder installed in the goniometer

5. Set the accelerating voltage.

5a. Obtain PAGE-1 on the CRT.

Note: PAGE-1, -2 ... or -6 is successively appears on the CRT every time the PAGE key is depressed.

5b. Set the ACCEL VOLTAGE value on the CRT to the desired value with the ACCEL VOLTAGES switch (Ll-4).

6. Turn on (built-in lamp lights up) the HT switch (L1-5) and confirm that the BEAM CURRENT meter (Li-6) reading (detecting current) becomes stable in the current range shown in Table 5.1. If the BEAM CURRENT meter reading does not become stable, carry out the following Steps.

Note: The ACCEL VOLTAGE READY lamp (Ll-3) flickers during accelerating voltage increment.

6a. Make sure that the FILAMENT READY lamp (L1-7) is lit and depress the accelerating voltage to the lowest level and slowly turn (approximately 1 graduation per 30 seconds) the FLLAMENT knob (L1-8) to the stopper position. The BEAM CURRENT meter reading increases. **Note:** The FILAMENT READY lamp (L1-7) does not light up when the specimen holder is out of the microscope column (goniometer).

6b. After the BEAM CURRENT meter reading becomes stable, set the FILAMENT knob to OFF, increase the accelerating voltage by 20 kV, and set the FILAMENT knob (L1-8) to the stopper position in the same way.

6c. Repeat Step 6b above until the original accelerating voltage is obtained.

Note: If the BEAM CURRENT reading becomes excessively high, the supply of high voltage power is automatically turned off and the BEAM CURRENT reading becomes 0. In such case, reduce the accelerating voltage to the next lower value and turn on the HT switch.

Table 5.1 High voltage and related detecting current values

High voltage (kV)	Detecting current (μA)
100	35 ± 10%
150	53 ± 10%
200	70 ± 10%
250	88 ± 10%
300	105 ± 10%

7. Set the largest condenser aperture into the electron beam path, and retract the high contrast

objective aperture and field limiting aperture from the path, as follows;

* Condenser aperture: Set the 2nd largest dot on knob 1 to the dot on the assembly (refer to Sect. 4.1).
* High contrast objective and field limiting apertures:
  Set the largest dot on knob 1 to the dot on the assembly.

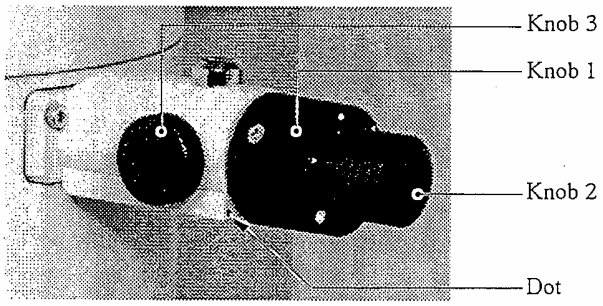


Fig. 5.2–13 Aperture assembly

8. Confirm that viewing chamber isolation valve V2 is open. If the large fluorescent screen is raised lower it by depressing the SCREEN switch (R1-1l). A diagram indicating which valve is open on control panel L2.

Note: If V2 is closed, the electron beam cannot be generated.

9. Gradually turn the FILAMENT knob (L1-8) to the knob stopper and adjust the BIAS MODE-COARSE and -FINE switches (L1-lU) so that the beam current is about 5 uA.

Note: The beam current is the difference between the BEAM CURRENT reading when the FILAMENT knob (Ll-8) is at the stopper position and that when the knob is at OFF.

10. Darken the room and adjust the control panel illumination with the PANEL LIGHT knob (Ll-9).

11. Obtain the spot size value of TEM2-3.
    11a. Let the CRT display PAGE-1.
    11b. Turn on the TEM (Ll-19).
    11e. set the SPOT SIZE value on PAGE-1 to TEM2-3 with the SPOT SIZE switch (L1-12) and a -SELECTOR knob (Ll-23).
12. Make sure that all the LENS switches (L3-i) are set at ON and depress the MAG2 switch (R1- 3).The magnification indicated on the MAG line on PAGE-1 is now set at the specific magnification (5,000 times).
13. Turn the BRIGHTNESS knob (Li-14). When the screen is illuminated by the electron beam, proceed to Step 19. If the fluorescent screen is not illuminated, carry out the following steps.
14. Turn on the DEFLECTOR-COND switch (R2-i); push the N switch (R2-iO); then turn off the PROJ switch (L3-i); and turn the BRIGHTNESS knob (Li-14). If no illumination is observed on the screen, proceed to Step 15. When illumination appears on the screen, manipulate the SHIFT-X and -Y knobs (Ll-17, R1-1) and BRIGHTNESS knob for brighter illumination; the turn on the PROJ switch and achieve brightest illumination with the above-mentioned knobs. Then proceed to Step 19.
15. Turn on the DEFLECTOR-GUN and WOBBLER-GUN switches (R2-i, 9) and manipulate the BRIGHTNESS knob (Li-i4) so that the fluorescent screen is illuminated by the electron beam.
16. Manipulate the SHIFT-Y and DEF-Y knobs (R2-2, 3) and the BRIGHTNESS knob (L1-14) so as to obtain the brightest illumination at the screen center.
17. Turn off the WOBBLER-GUN and DEFLECTOR-GUN switches (R2-1, 9).
18. Manipulate the SHIFT-X and DEF-X knobs (R2-2, 3) and the BRIGHTNESS knob (L1-14) So as to obtain the brightest illumination. If the illumination becomes gloomy in the course of this operation, stop manipulating the knobs, turn on the PROJ switch (L3-1) and manipulate the knobs again so as to obtain the brightest illumination.

    Note: Do not allow the illumination to become too bright with the PROJ switch (L3-1) off; otherwise the fluorescent screen may burn due to excessive electron bombardment.
19. Perform the condenser lens alignment as follows:
    a) Set the magnification to 50,000 times and obtain the smallest beam spot with the BRIGHTNESS knob.
    b) Set the spot size value to TEM1-3.
    c) Turn on the DEFLECTOR-GUN switch (R2-1) and center the beam spot with the SHIFT knobs (R2-2).
    d) Set the spot size value to TEM4-3.
    e) Center the beam spot with the left and right SHIFT knobs (L1-17, R1-1).
    f) Repeat Steps 19b through 19e until the beam spots with the spot sizes of TEM 1-3 and 4-3 remain at the screen center.

5.2.7 Inserting the Condenser Aperture into the Beam Path

1. Depress the MAG2 switch (Ri-3); manipulate the BRIGHTNESS knob (L1-14) so as to obtain the smallest illumination spot, and bring the converged illumination spot to the screen center with the SHIFT-X and -Y knobs (L1-17, R1-1).

2. Select the desired aperture size with knob 1 (Fig. 5.2-14).
3. Note: Decreasing the aperture size improves the image quality, but darkens the image.

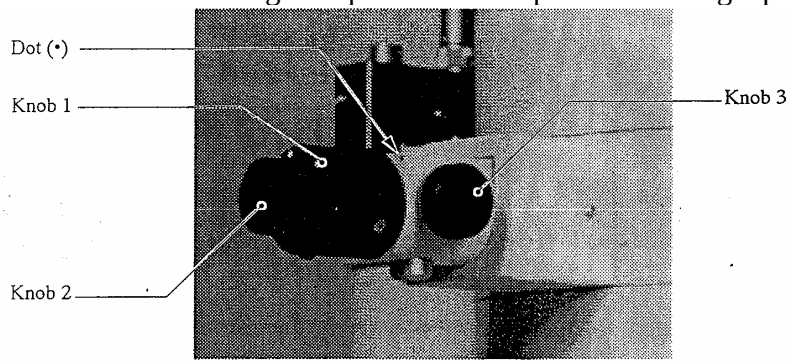
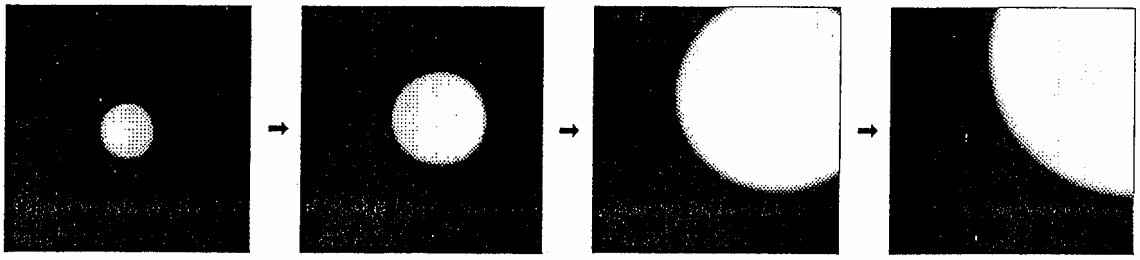
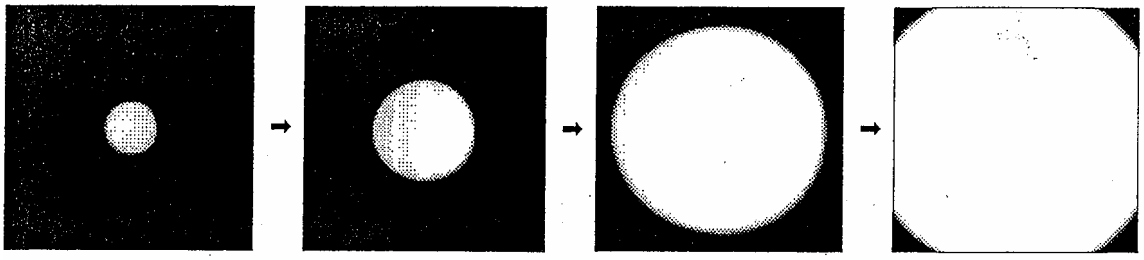


Fig. 5.2–14 Condenser aperture assembly

4. Gradually turn the BRIGHTNESS knob (L1-14) clockwise. If the illumination spot center deviates from the screen center (Fig. 5.2-15a); return the spot to the screen center by manipulating knobs 2 and 3.
5. Manipulate knobs 2 and 3 so that the illumination spot concentrically converges on and spreads from the screen center (Fig. 5.2-15b) when the BRIGHTNESS knob (L1-14) is turned clockwise and counterclockwise around the position for the smallest illumination spot.



a: Incorrectly aligned



b: Correctly aligned

Fig. 5.2–15 Condenser aperture alignment

5~2.8 Image Observation

1. Turn on the TEM switch (Li-19) to obtain an illumination mode of TEM, and set the spot size value (displayed on the second line on PAGE-1) to TEM2-3 with the SPOT SIZE switch (L1-12) and a -SELECTOR knob (L1-23).
2. Set the magnification to 50,000 times and converge the electron beam with the BRIGHTNESS knob (L1-14).
3. Turn on the WOBBLER-IMAGE X or Y switch (R1-5). The electron beam may be divided into two.
4. Make the divided beam single with the OBJ FOCUS knob (R1-4).
5. Diverge the electron beam with the BRIGHTNESS knob (Li-i4) and obtain a single stationary beam, if the image has been doubled, with the Z CONT switch (Fig. 3.3-1).
6. Turn off the WOBBLER-IMAGE X and Y switches (R1-5).
7. Select the desired field of view with the trackball (SC-4) or X, Y switches (SC-3)
   Notes: 1. The selected field of view is indicated by a square mark on PAGE-2 on the CRT (see Sect. 4.3)
   2. If "LIMIT OVER" appears on the CRT bottom with a weak peep sound and specimen shifting is halted, move the specimen in the opposite direction, depress the ESC key. (KB-1) to erase the "LIMIT OVER" on the CRT.
8. Let the CRT display PAGE-3 and confirm that the name of the objective polepiece being used is displayed on PAGE-3. If the displayed name is different from that of the pole piece being used, carry out Sect. 5.2.12
   Note: If the objective polepiece name displayed on PAGE-3 is different from the name of the polepiece being used, the correct magnification is not displayed.
9. Select the desired magnification with the SELECTOR switch (R1-7) (a suitable magnification less than 50,000 times) and adjust the image brightness width the BRIGHTNESS knob (L1-14). If the illumination spot center does not coincide with the screen center, center the illumination spot with the SHIFT-X and -Y knobs (L1-17, R1-1) Note: If a magnification is selected with the MAG2 switch (Ri-3) depressed, the selected magnification is not stored in the memory. However, if a magnification is selected with the MAG1 switch (R1-3) depressed, the selected magnification is not stored in the memory. That is to say, the magnification is automatically set to the stored value by depressing the MAG1 switch. On the other hand, by depressing the MAG2 switch, the magnification is always set to a specific magnification (Sect. 5.2.12).

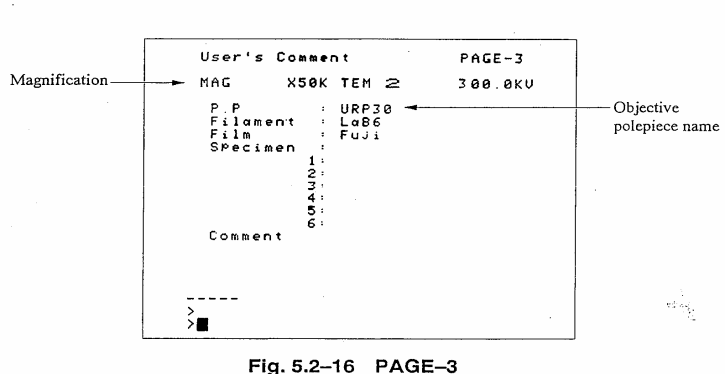


Fig. 5.2–16 PAGE–3

5.2.9 Inserting the High Contrast Objective Aperture into the Beam Path

1. Insert a specimen into the beam path (see Sects. 5.2.3 and 5.2.4) and, depress the DIFF switch (R1-3). Keep the electron beam sufficiently spread with the BRIGHTNBSS knob (L1-14).
2. Obtain a caustic spot (zero magnification spot) with the DIFF FOCUS knob (R1-6) as shown in Fig. 5.2-17. If the caustic spot is off the screen center, turn on the DEFLECTOR-PROJ switch (R2-1) and center the spot with the SHIFT knobs (R2-2). Turn off the DEFLECTOR-PROJswitch (R2-1) after centering.

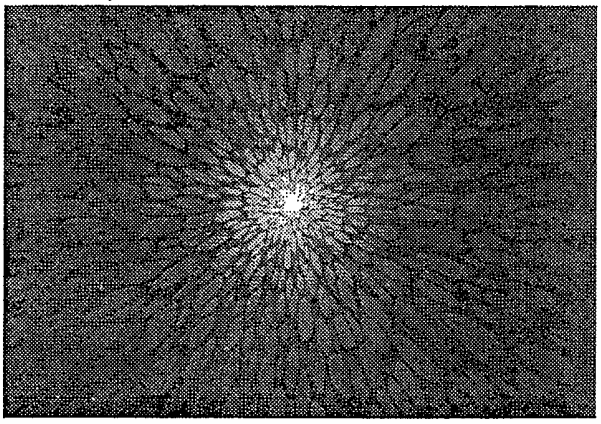


Fig. 5.2–17 Caustic spot

3. Obtain the smallest illumination spot with the BRIGHTNESS knob (L1-14) and make the illumination spot coincide with the screen center by manipulating the SH[FT-X and -Y knobs (L1-17, R1-1).
4. Manipulate aperture assembly knob 1 (Fig. 4.1-3) to insert~a desired objective aperture into the beam path.
5. Focus the aperture image (shadow) with the DIFF FOCUS knob (R1-6).
6. Manipulate assembly's knob 2 and 3 so that the caustic spot lies in the center of the aperture hole image as shown in Fig. 5.2-18.

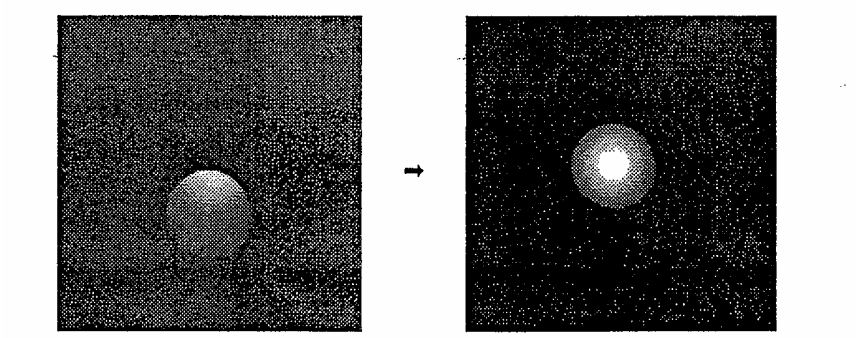


Fig. 5.2–18 Objective aperture alignment

5.2.10 Image Recording by Automatic Exposure

1. Turn on the SHUTTER AUTO switch (R1-12) and turn off the FILM ADVANCE AUTO switch(R1-1l).
2. Bring the field of view to be photographed into a photographing area (frame) on the fluorescent screen with the trackball as shown in Fig. 5.2-19.
   Note: A large frame and a small frame are drawn on the fluorescent screen. The large frame is used for photography using special films.

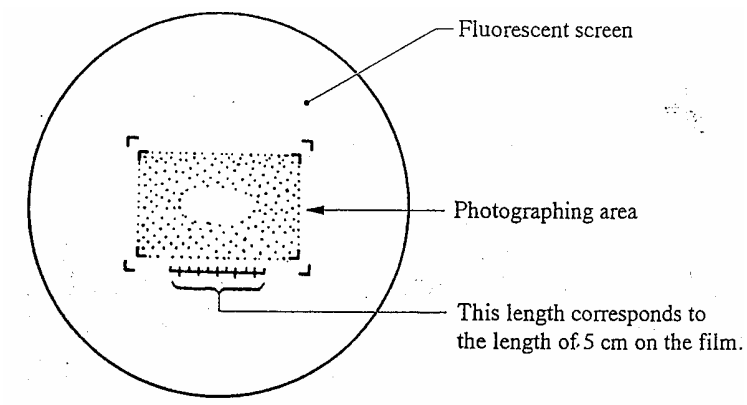


Fig. 5.2–19 Photographing area

3. Write the information to be recorded on the film on PAGE-1. 2 characters can be written on the FILM NO line and 18 characters on the TEXT line (Fig. 5.2-20).

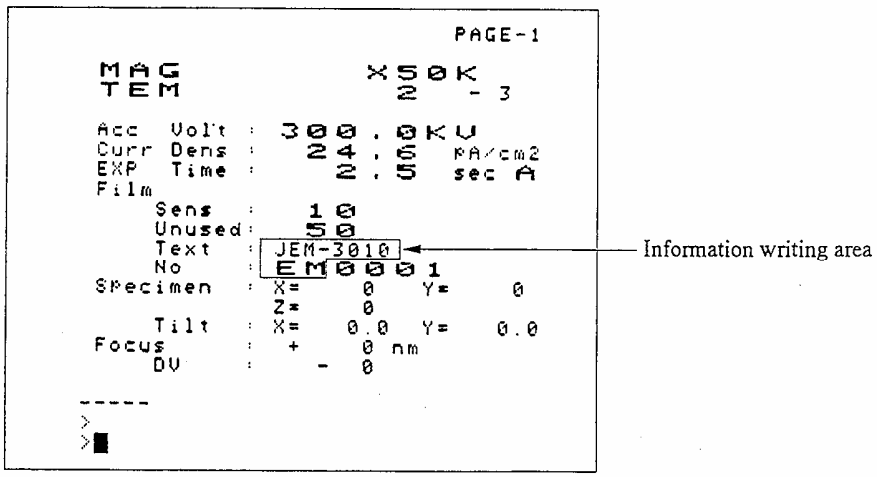


Fig. 5.2–20 Information writing area

4. **Focus the image**.
   a. Push the fluorescent screen lever (Fig. 5.2-21) until it stops. The small fluorescent screen is now inserted into the beam path.

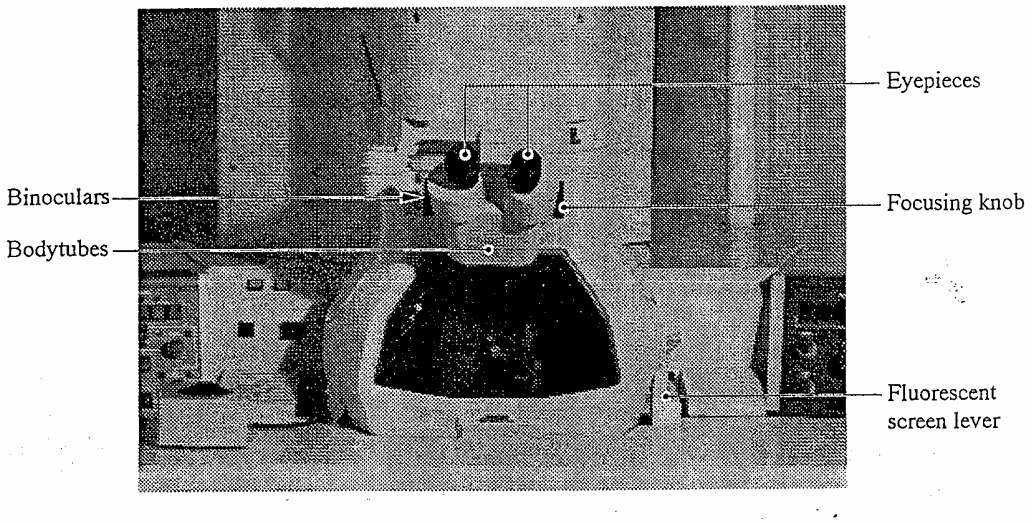


Fig. 5.2–21 Binoculars

   b.
   c. Focus the binoculars on the small fluorescent screen
      Note: First, focus the whole binoculars with the focusing knobs, and adjust, if necessary, the intraocular distance by changing the distance between the bodytubes, and focus the eyepieces by turning the knurled ring (Fig. 5.2-21)."
   d. Turn on the WOBBLER-IMAGE X or -IMAGE Y switch (R1-5). If the illumination spot oscillates or divides into two spots, manipulate the OBJ FOCUS (R1-4). to obtain a single stable illumination spot.

e. Observe an image with clear contours on the small fluorescent screen through the binoculars. If the image appears as a double image, adjust the Z CONT switch (Fig. 3.3-1) so as to obtain a single stationary image. If the image is underfocused or overfocused, it will appear as a double image as shown in Fig. 5.2-22.
f. Turn off the WOBBLER-IMAGE X or -IMAGE Y switch (R1-5).

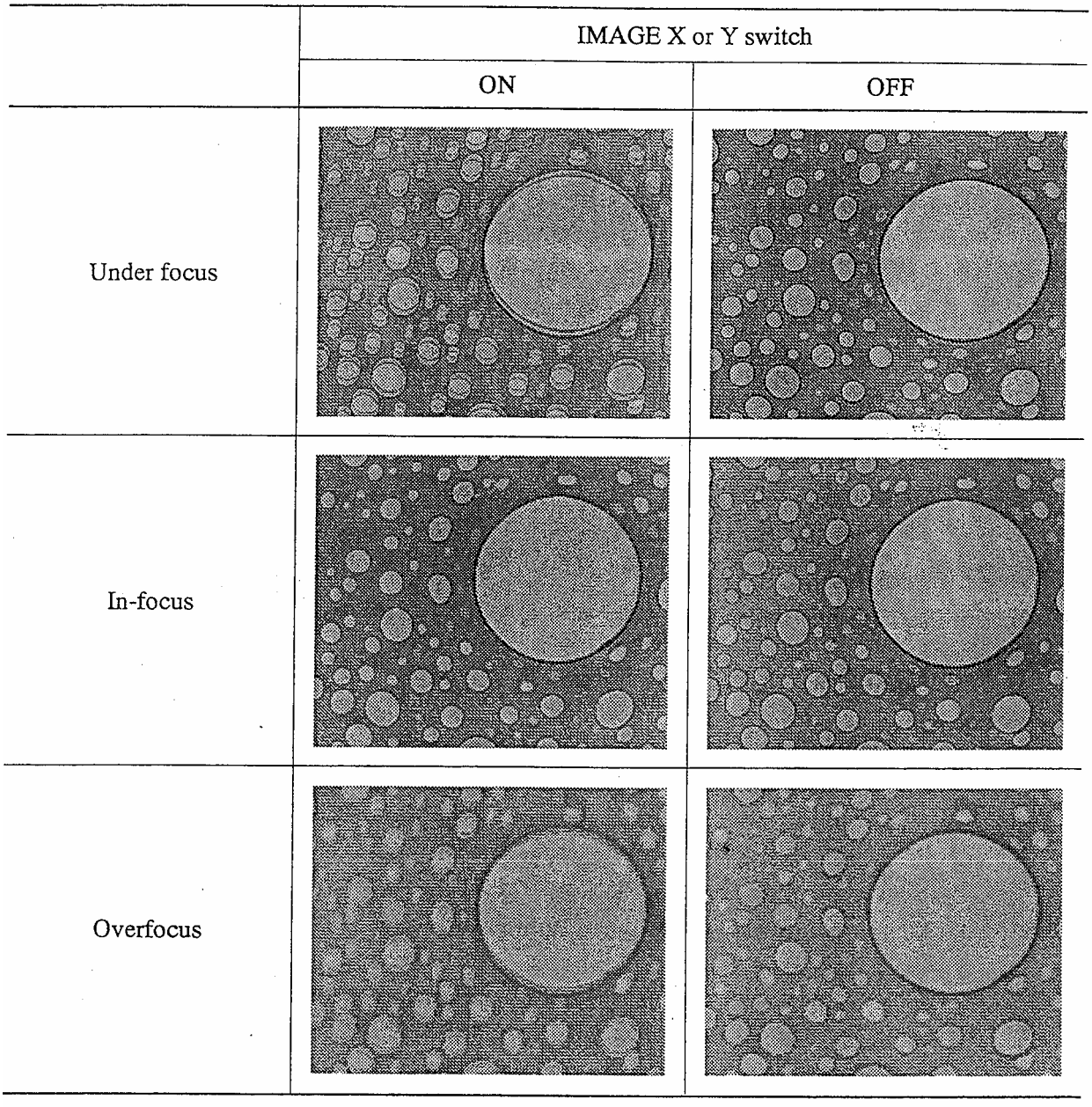


Fig. 5.2–22 Focusing with the image wobbler

5. **Adjust the image brightness.**
    a. Obtain PAGE-4 on the CRT.
    b. Adjust the BRIGHTNESS knob (L1-14) so that the exposure time displayed on the EXPTime line becomes the desired value (usually 2 to 4 sec).

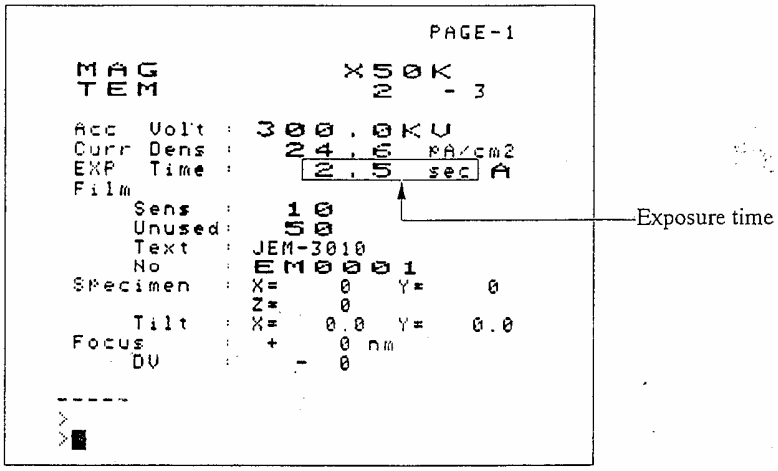


Fig. 5.2–23 Exposure time

6. Depress the PHOTO switch (R1-8) with the small screen in the beam path, and after the built-in lamp of the switch lights up, depress the PHOTO switch again. Photographing is carried out. If the built-in lamp is already on, depress the PHOTO switch only once.
    Notes:
        1) The EXP lamp (R1-9) lights up and remains lit while the shutter is open. The built-in lamp of the PHOTO switch (R1-8) goes out when the exposed film is advanced from the exposing position.
        2) The PHOTO switch lamp does not light when all loaded films have been exposed.
        3) The exposure time is determined by an amount of entire electrons either on the small or large fluorescent screen. Therefore, removing the small screen out of beam path, when the large screen is entirely illuminated, does not affect the correct exposure time determination.

5.2.11 Film Processing

1) Unload the receiving magazine from the camera chamber (see Sect. 5.2.2b).
2) Adjourn to a darkroom and remove the lid from the receiving magazine and the cassettes from the magazine under a safelight (red lamp).
3) Carefully remove the film from the cassette (Fig. 5.2-24).

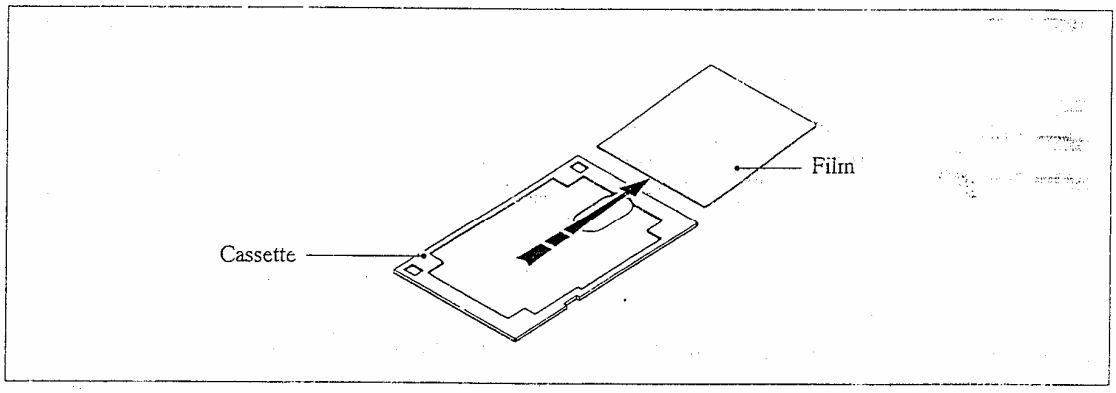


Fig. 5.2-24 Removing the film from the cassette

4) Immerse the film in a developer (20 ± 0.5 °C); and leave it in until the exposed latent image becomes sufficiently visible (usually three or four minutes; Fig. 5.2-25). During the developing process, agitate the developer or move the film in order to avoid developing marks.
   Note: If only a few films are to be processed, developing trays may be used. However, if many films are to be processed at one time, it is recommended to use suitable tanks and hangers (stainless steel tanks, polyvinyl chloride tanks, etc. are the best).
5) Immerse the film in a stop bath (2 to 3% glacial acetic acid solution, 18 to 21 °C) and leave it in for approx. 30 seconds. This is to suspend development so as to prevent the film from becoming blotchy and to prolong the effectiveness of the fixer.
6) Immerse the film in a rapid acid hardening fixer (18 to 21 °C) and leave it in for approximately ten minutes (the fixing time should be at least two or three times the time it takes for the negative to clear).This is to dissolve the photosensitive silver halide (white part of the film) and thereby make the unexposed part of the film transparent. Thereafter, processing can be carried out under an ordinary light.

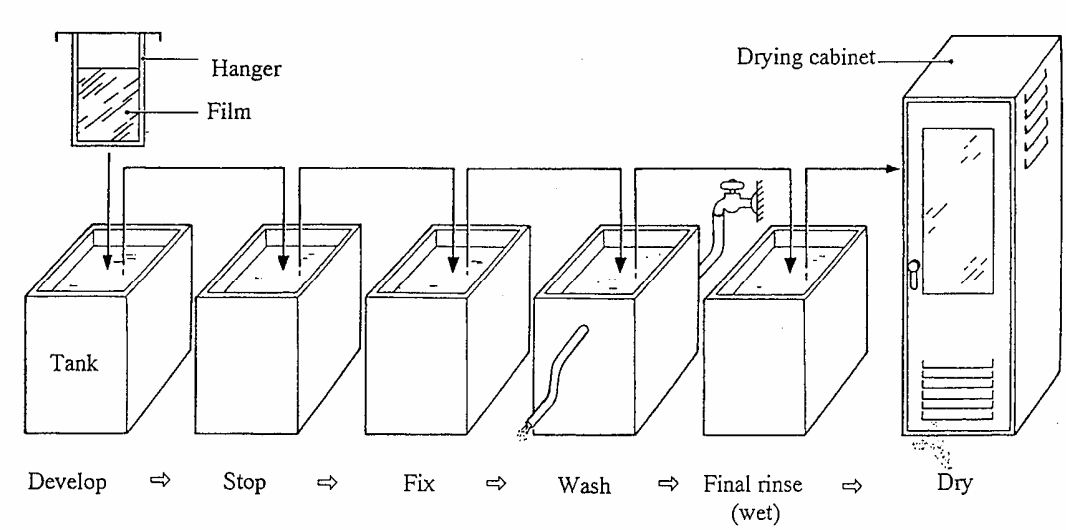


Fig. 5.2–25 Film processing

7) Wash the film in running water (15 to 2000) for 30 to 60 minutes. This removes the complex salt and fixing solution. The washing time can be considerably reduced by immersing the film in a rinse accelerator prior to washing it in running water.

8) Immerse the film in a final rinse bath (weak solution of anionic surfactant, 18 to 21 °C) and leave it in for approx. 30 seconds (or wipe both surfaces of the film carefully with a soft sponge). By so doing, film drying time is reduced and film blisters are prevented.

9) Dry the film in a drying cabinet (the cabinet need not be large); or dry it naturally by hanging it in a well-ventilated, dust-free place away from direct sunlight. Store the dried film in a negative bag (polyethylene, cellophane, etc.) and keep the bag in a dry place away from direct sunlight. Note: Consequences of faulty film processing, etc. are listed in Table 5.2 (assuming that the exposure is in order).

Table 5.2 Consequence of faulty film processing

Appearance	Possible cause
• No picture	• Film inserted into cassette upside-down.
• Complete blackening	• Magazine lid inadvertently opened while being carried.
• Fogging	• Faulty safelight.
	• Film processing date has expired.
• High density	• Developer temperature too high.
• Low density	• Developer temperature too low.
• Too grainy	• Developing time too long.
• Uneven density	• Developing time too short.
	• Effete developer.
• Spotty staining (mottled)	• Developer agitation insufficient.
	• Film electrostatically charged before developing.
• Scratches, streaks	• Film emulsion surface rubbed.
• Discoloration of film during storage	• Fixing and rinsing insufficient.
• Moldy film	• Method and place of storage unsuitable.
	• Drying insufficient.
• Extraneous particulates	• Impurities in tap water.
• Blisters on film	• Water droplets left on film before drying.
• Reticulation	• Tap water temperature too high.